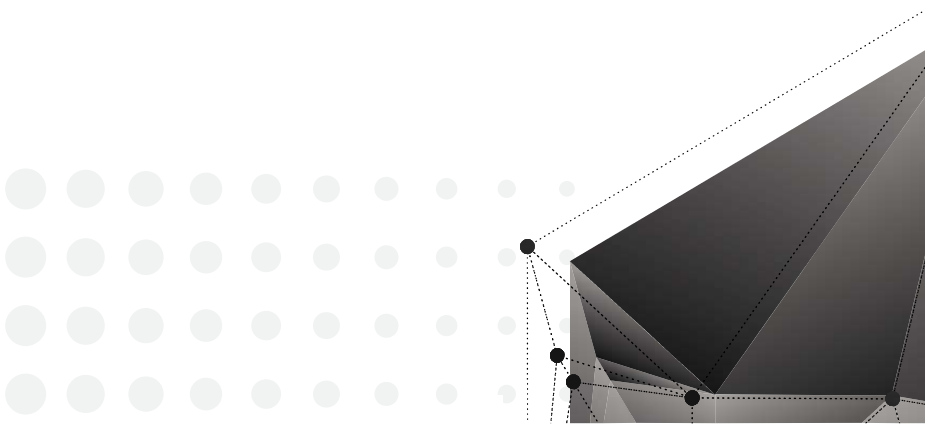


**FOURTH SEMESTER**

**'CONSTRUCTION AUTOMATION'**





## ADVANCED SURVEYING

<b>Course Code:</b>	024001
<b>Course Title</b>	Advanced Surveying
<b>No. of Credits</b>	6 (TH:4,T:0,P:4)

**COURSE OUTCOMES:** At the end of the course, the student will be able to:

1. Demonstrate proficiency in plane table surveying technique.
2. Apply contouring methods to accurately represent landforms and elevation changes, use of stadia measurements, interpretation of contour maps and computation of earthwork and reservoir capacity.
3. Perform theodolite surveying tasks with precision.
4. Apply tachometric surveying principles and instruments to measure distances and angles effectively using stadia tachometry and solve numerical problems related to tachometry.
5. Understand the concept and setting out of simple circular curves and the importance of transition curves and vertical curves in road design.
6. Get familiarity with modern surveying equipment and techniques, including Electronic Distance Measurement (EDM) devices, Total Stations, remote sensing, and Global Positioning System (GPS) and understand their applications and benefits in surveying projects.

## **DETAILED CONTENTS**

### **1. Plane Table Surveying**

- 1.1 Purpose of plane table surveying, equipment used in plane table survey:
- 1.2 Setting of a plane table:
  - (b) Centering
  - (c) Levelling
  - (d) Orientation
- 1.3 Methods of plane table surveying
  - (a) Radiation,
  - (b) Intersection
  - (c) Traversing
  - (d) Resection
- 1.4 Concept of Two point and Three point problems (Concept only)
- 1.5 Errors in plane table survey and precautions to control them. Testing and adjustment of plane table and alidade

### **2. Contouring:**

Concept of contours, purpose of contouring, contour interval and horizontal equivalent, factors effecting contour interval, characteristics of contours, methods of contouring: Direct and indirect, use of stadia measurements in contour survey, interpolation of contours; use of contour map, Drawing cross section from a contour map; marking alignment of a road, railway and a canal on a contour map, computation of earth work and reservoir capacity from a contour map

### **3. Theodolite Surveying:**

Working of a transit vernier theodolite axes of a theodolite and their relation; temporary adjustments of a transit theodolite; concept of transiting, swinging, face left, face right and changing face; measurement of horizontal and vertical angles. Prolonging a line (forward and backward) measurement of bearing of a line; traversing by included angles and deflection angle method; traversing by stadia measurement, theodolite triangulation, plotting a traverse; concept of coordinate and solution of omitted measurements (one side affected), errors in theodolite survey and precautions taken to minimize them; limits of precision in theodolite traversing. Height of objects – accessible and non-accessible bases

### **4. Tacho-metric surveying**

Tachometry, Instruments to be used in tachometry, methods of tachometry, stadia system of tachometry, general principles of stadia tachometry, examples of stadia tachometry and Numerical problems.

### **5. Curves:**

5.1 Simple Circular Curve: Need and definition of a simple circular curve; Elements of simple circular curve - Degree of the curve, radius of the curve, tangent length, point of intersection (Apex point), tangent point, length of curve, long chord deflection angle, Apex distance and Mid-ordinate. Setting out of simple circular curve:

- a) By linear measurements only:
  - i) Offsets from the tangent
  - ii) Successive bisection of arcs
  - iii) Offsets from the chord produced
- b) By tangential angles using a theodolite

5.2 Transition Curve: Need (centrifugal force and super elevation) and definition of transition curve; requirements of transition curve, types of transition curve.

5.3 Vertical curve: Need and definition of vertical curve, requirements of vertical curve, types of vertical curve.

**6. Introduction to the use of Modern Surveying equipment and techniques such as:**

- a) EDM or Distomat
- b) Total station
- c) Introduction to remote sensing and GPS

**NOTE: No sketch of the instruments will be asked in the examination.**

**PRACTICAL OUTCOMES:** At the end of the course, the student will be able to:

1. Gain proficiency in plane table surveying techniques, including equipment setup, orientation, and data collection using radiation, intersection, and resection methods. Perform traversing tasks with a plane table.
2. Master contouring methods, such as radial line method and method of squares, to prepare accurate contour plans of various land features, including roads, railways, and canals.
3. Develop skills in using a transit vernier theodolite, including temporary adjustments, measurement of horizontal and vertical angles, determination of magnetic bearing, and running closed traverses. Understand height measurement techniques using accessible and non-accessible bases.
4. Acquire the ability to set out a simple circular curve using both chain and tape method and theodolite method.
5. Gain practical knowledge of digital surveying instruments through field visits to Survey of India and other government agencies.
6. Familiarize with the principles and functions of Total Station through demonstrations.

### **List of Practical :**

#### **1. Plane Table Surveying:**

- a) Study of the plane table survey equipment
- b) Setting the plane table
- c) Marking the North direction
- d) Plotting a few points by radiation method
- b) Orientation by
  - Trough compass
  - Back sighting
- c) Plotting few points by intersection, radiation and resection method
- d) Traversing an area with a plane table (at least five lines)

#### **2. Contouring:**

- a. Preparing a contour plan by radial line method by the use of a Tangent Clinometers/Tachometer
- b. Preparing a contour plan by method of squares
- c. Preparing a contour plan of a Road/Railway track/Canal by taking cross sections

#### **3. Theodolite:**

- a. Taking out the Theodolite, mounting on the tripod and placing it back in the box
- b. Study of a transit vernier theodolite; temporary adjustments of theodolite
- c. Reading the vernier and working out the least count, measurement of horizontal angles by repetition and reiteration methods



- d. Measurement of vertical angles and use of tachometric tables
- e. Measurement of magnetic bearing of a line
- f. Running a closed traverse with a theodolite (at least five sides) and its plotting
- g. Height of objects with and without accessible bases

**4. Curves**

- a. Setting out of a simple circular curve with given data by the following methods
  - i. Chain and Tape Method
  - ii. One Theodolite method
- 5. Demonstration of digital instruments through field visits to Survey of India and other government agencies.
- 6. Total Station (only demonstrations).

**Recommended Books:**

1. Hussain, SK and Nagraj, MS "Text Book of Surveying";, S Chand and Co Ltd., New Delhi
2. Deshpande, RS "A Text Book Surveying and Levelling"; United Book Corporation, Pune,
3. Kocher, CL; "A Text Book of Surveying"; Katson Publishing House Ludhiana,
4. Kanetkar, TP and Kulkarni, SV., "Surveying and Leveling", Poona, AVG Parkashan, Pune
5. Kanetkar, TP; and Kulkarni, SV; "Surveying and Leveling-Vol.2" AVG Prakashan, Pune
6. Punima, BC; "Surveying and Leveling ", Standard Publishers Distributors, Delhi
7. Shahai, PB; "A Text Book of Surveying ", Oxford and IBH Publishing Co.
8. Lilly Sant "Remote Sensing and Image Interpretation"
9. Mahajan, Sanjay, "Surveying-II", Satya Prakashan, Delhi

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## **CONCRETE TECHNOLOGY**

<b>Course Code:</b>	024002
<b>Course Title</b>	Concrete Technology
<b>No. of Credits</b>	6 (TH:4,T:0,P:4)

**COURSE OUTCOMES:** At the end of the course, the student will be able to:

1. Develop a comprehensive understanding of concrete, including its definition, uses and advantages over other building materials.
2. Gain knowledge of the ingredients of concrete. Understand the classification and characteristics of aggregates, quality requirements for water.
3. Comprehend the significance of the water-cement ratio and its impact on concrete strength.
4. Acquire the skills to assess the workability of concrete through various tests.
5. Study the properties of concrete in both its plastic and hardened states.
6. Gain practical knowledge of storing and handling of cement and aggregates, batching of materials, mixing techniques (both manual and machine), transportation methods, placement procedures, compaction techniques, curing methods, jointing techniques.

## **COURSE CONTENTS**

- 1. Introduction:** Definition of concrete, uses of concrete in comparison to other building Materials.
- 2. Ingredients of Concrete:**
  - 2.1 Cement: physical properties of cement; different types of cement as per IS Codes
  - 2.2 Aggregates:
    - 2.2.1 Classification of aggregates according to size and shape
    - 2.2.2 Characteristics of aggregates: Particle size and shape, surface texture, specific gravity of aggregate; bulk density, water absorption, surface moisture, bulking of sand, deleterious materials, soundness
    - 2.2.3 Grading of aggregates: coarse aggregate, fine aggregate; All-in- aggregate, fineness modulus; interpretation of grading charts
  - 2.3 Water: Quality requirements as per IS:456-2000
- 3. Water Cement Ratio:**
  - 3.1 Hydration of cement, principle of water-cement ratio, Duff Abram's Water-cement ratio law: Limitations of water-cement ratio law and its effects on strength of concrete
- 4. Workability:**
  - 4.1 Workability factors affecting workability, Measurement of workability: slump test, compacting factor and Vee Bee consistometer; Recommended slumps for placement in various conditions as per IS:456-2000/SP-23

## **5. Properties of Concrete:**

- 5.1 Properties in plastic state: Workability, Segregation, Bleeding and Harshness
- 5.2 Properties in hardened state: Strength, Durability, Impermeability, Dimensional changes;

## **6. Proportioning for Normal Concrete:**

- 6.1 Objectives of mix design, introduction to various grades as per IS:456-2000; proportioning for nominal mix design as prescribed by IS 456-2000
- 6.2 Adjustment on site for: Bulking of fine aggregate, water absorption of aggregate, workability
- 6.3 Difference between nominal and controlled concrete
- 6.4. Introduction to IS-10262-2009-Code for controlled mix design

## **7. Introduction to Admixtures (chemicals and minerals):** for improving performance of concrete

## **8. Special Concretes (only features)**

- 8.1 Concreting under special conditions, difficulties and precautions before, during and after concreting
  - 8.1.1 Cold weather concreting
  - 8.1.2 Under water concreting
  - 8.1.3 Hot weather concreting
- 8.2 Ready mix concrete
- 8.3 Fibre reinforced concrete
- 8.4 Polymer Concrete

8.5 Fly ash concrete

8.6 Silica fume concrete

## **9. Concreting Operations:**

### **\*\*9.1 Storing of Cement:**

9.1.1 Storing of cement in a warehouse

9.1.2 Storing of cement at site

9.1.3 Effect of storage on strength of cement

9.1.4 Determination of warehouse capacity for storage of Cement

### **\*\*9.2 Storing of Aggregate: Storing of aggregate at site**

### **9.3 Batching (to be shown during site visit )**

9.3.1 Batching of Cement

9.3.2 Batching of aggregate by:

9.3.2.1 Volume, using gauge box (farma)  
selection of proper gauge box

9.3.2.2 Weight spring balances and batching machines

9.3.3 Measurement of water

### **\*\*9.4 Mixing:**

9.4.1 Hand mixing

9.4.2 Machine mixing - types of mixers, capacities of mixers, choosing appropriate size of mixers, operation of mixers

9.4.3 Maintenance and care of machines

### **\*\*9.5 Transportation of concrete: Transportation of concrete using: wheel barrows, transit mixers, chutes, belt conveyors, pumps, tower crane and hoists etc.**

## 9.6 Placement of concrete:

Checking of form work, shuttering and precautions to be taken during placement

## \*\* 9.7 Compaction:

9.7.1 Hand compaction

9.7.2 Machine compaction - types of vibrators, internal screed vibrators and form vibrators

9.7.3 Selection of suitable vibrators for different situations

## 9.8 Finishing concrete slabs - screeding, floating and trowelling

## 9.9 Curing:

9.9.1 Objectives of curing, methods of curing like ponding, membrane curing, steam curing, chemical curing

9.9.2 Duration for curing and removal of form work

9.10 Jointing: Location of construction joints, treatment of construction joints, expansion joints in buildings - their importance and location

9.11 Defects in concrete: Identification of and methods of repair

## **10. Importance and methods of non-destructive tests (introduction only)**

**NOTE:\*\* A field visit may be planned to explain and show the relevant things**

**PRACTICAL OUTCOMES:** At the end of the course, the student will be able to:

1. Understand the physical properties of cement as per IS Codes, including fineness, consistency, setting time, soundness, and compressive strength.
2. Perform tests to determine the flakiness and elongation index of coarse aggregates, which are important indicators of the shape and angularity of the aggregates.
3. Conduct tests to determine the presence of silt in fine aggregates, which can impact the quality and workability of concrete.
4. Determine the specific gravity and water absorption of aggregates, which are crucial parameters for assessing the quality and proportioning of concrete mixes.
5. Calculate the bulk density and voids of aggregates to assess their compactness and void content, which can affect the overall density and strength of concrete.
6. Determine the surface moisture in fine aggregates using the displacement method, allowing for the evaluation of moisture content and its influence on concrete properties.



**List of Practicals:**

1. To determine the physical properties of cement as per IS Codes
2. To determine flakiness and elongation index of coarse aggregates
3. To determine silt in fine aggregate
4. Determination of specific gravity and water absorption of aggregates
5. Determination of bulk density and voids of aggregates
6. To determine surface moisture in fine aggregate by displacement method
7. Determination of particle size distribution of fine, coarse and all in aggregate by sieve analysis (grading of aggregate)
8. To determine necessary adjustment for bulking of fine aggregate
9. To determine workability by slump test:
10. To verify the effect of water, fine aggregate/coarse aggregate ratio and aggregate/Cement ratio on slump
11. Compaction factor test for workability
12. Non destructive test on concrete by:
  - Rebound Hammer Test
  - Ultrasonic Pulse Velocity Test
13. Tests for compressive strength of concrete cubes for different grades of concrete

### **Recommended Books:**

1. Kulkarni, PD; Ghosh, RK and Phull, YR; "Text Book of Concrete Technology"; Oxford and IBH Publishing Co. New Delhi
2. Krishnamurthy, KT Rao, A Kasundra & Khandekar, AA; "Concrete Technology"; Dhanpat Rai & Sons, Delhi,
3. Gupta BL and Gupta Amit; "Text Book of Concrete Technology"; Standard Publishers Distributors, Delhi.
4. Varshney, RS;"Concrete Technology";, Oxford and IBH Publishing, New Delhi
5. Neville, AM; "Properties of Concrete", Pitman (ELBS Edition available), London
6. Orchard; "Concrete Technology"; Vol I, II, and III
7. Handoo, BL; Puri, LD and Mahajan Sanjay "Concrete Technology"; Satya Prakashan, New Delhi,
8. Sood, Hemant, Mittal LN and Kulkarni PD; "Laboratory Manual on Concrete Technology", CBS Publishers, New Delhi, 2002
9. Vazirani, VN; and Chandola, SP; "Concrete Technology"; Khanna Publishers, Delhi,
10. Gambhir, ML; "Concrete Technology";, MacMillan India Ltd., New Delhi
11. Siddique, R., "Special Structural Concretes", Galgotia Publishers Pvt. Ltd. Delhi
12. Birinder Singh, "Concrete Technology", Kaption Publications, Ludhiana,
13. Module on Special Concretes by Dr Hemant Sood, NITTTR Chandigarh
14. Concrete Technology by P Dayaratman
15. Video programme on different experiments in „Concrete Technology developed by NITTTR, Chandigarh

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## CONSTRUCTION EQUIPMENT & AUTOMATION

<b>Course Code:</b>	484001
<b>Course Title</b>	Construction Equipment and Automation
<b>No. of Credits</b>	5 (TH:4,T:0,P:2)

**COURSE OUTCOMES:** At the end of the course, the student will be able to:

1. Identify and classify various types of construction equipment, understanding their uses and selection criteria for different construction projects.
2. Manage construction equipment efficiently, including maintenance, replacement, and disposal strategies, and analyze the cost implications of equipment usage.
3. Evaluate the advantages & disadvantages of automation in construction, recognizing different types of automation and its potential applications in the construction industry.
4. Demonstrate knowledge of earthmoving and excavation equipment, including their operating principles, applications, and safety considerations.
5. Understand lifting and material handling equipment, including their operating principles, applications, and safety protocols in construction projects.
6. Describe different types of construction vehicles, their operating principles, and applications, while adhering to safety practices.

## **DETAILED CONTENTS**

### **1. Introduction to construction equipment**

- Types of construction equipment
- Classification of construction equipment
- Uses of construction equipment
- Selection criteria for construction equipment

### **2. Construction equipment management**

- Maintenance of construction equipment
- Equipment replacement and disposal
- Cost analysis of construction equipment
- Safety in operating construction equipment

### **3. Automation in construction**

- Advantages & disadvantages of automation in construction
- Types of automation in construction
- Application of automation in construction
- Future trends in automation in construction

### **4. Earthmoving and excavation equipment**

- Types of earthmoving and excavation equipment
- Operating principles of earthmoving & excavation equipment
- Applications of earthmoving and excavation equipment
- Safety considerations for earthmoving & excavation equipment

### **5. Lifting and material handling equipment**

- Types of lifting and material handling equipment

- Operating principles of lifting & material handling equipment
- Applications of lifting and material handling equipment
- Safety considerations for lifting and material handling equipment

#### **6. Construction vehicles**

- Types of construction vehicles
- •Operating principles of construction vehicles
- •Applications of construction vehicles
- •Safety considerations for construction vehicles

#### **7. Introduction to robotics in construction**

- Types of robots used in construction
- Operating principles of construction robots
- Applications of construction robots
- Safety considerations for construction robots

#### **8. Case studies in construction equipment & automation**

- Real-world examples of the use of construction equipment and automation in construction projects
- Analysis of the benefits and challenges of using construction equipment and automation in construction projects

**Practical Outcomes:** Students will be able to

1. Gain proficiency in identifying, classifying, and operating various construction equipment and vehicles, focusing on their applications and safety.
2. Develop skills in performing maintenance checks, identifying repair needs, and implementing corrective actions for construction equipment.
3. Acquire the ability to analyze and interpret cost data to understand the economic implications of equipment management throughout its lifecycle.
4. Understand and apply automation and robotics in construction, evaluating their efficiency, effectiveness, and safety in construction projects.
5. Enhance comprehension and experience in the applications and safety considerations of various traditional and emerging construction technologies.

**List of Practical:**

1. To identify and classify different types of construction equipment by visiting a construction site or use online resources to identify various types of construction equipment and classify them based on their uses and operating principles.
2. To understand the maintenance procedures of construction equipment and perform routine maintenance checks on construction equipment, identifying any areas that require attention or repair.
3. To analyze the costs associated with construction equipment and gather data on the acquisition, operation, maintenance, and disposal costs of different construction equipment and perform a cost analysis.

4. To explore the advantages and disadvantages of automation in construction and use simulation software to model automated construction processes and evaluate their efficiency, effectiveness, and impact on project outcomes.
5. To understand the operating principles of earthmoving and excavation equipment and operate earthmoving and excavation equipment in a controlled environment, focusing on safety considerations and applications.
6. To gain hands-on experience with lifting and material handling equipment and operate various lifting and material handling equipment, focusing on their operating principles, applications, and safety considerations.
7. To understand the operating principles of construction vehicles and operate different types of construction vehicles, focusing on their applications and safety considerations.
8. To explore the applications of robots in construction and interact with or observe construction robots, studying their operating principles, applications, and safety considerations by visiting a construction site or use online resources.

**References:**

1. "Construction Automation and Robotics" by Thomas Linner
2. "Automation in Construction" edited by Nabil Kartam and Richard F. LaScola
3. "Advances in Construction Automation and Robotics" edited by Carlos T. Formoso and Sidney M. Levy
4. "Construction Robotics: Technology, Business, and Policy" by Thomas Bock, Thomas Linner, and Jan Wiendl.
5. "Building a Revolution: The Art of the Construction in the Digital Age" by James W. McHugh, Jr. and Brian J. Cuddy

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## TRANSPORTATION ENGINEERING

<b>Course Code:</b>	444002
<b>Course Title</b>	Transportation Engineering
<b>No. of Credits</b>	5 (TH:4,T:0,P:2)

**COURSE OUTCOMES:** At the end of the course, the student will be able to:

1. Understand the importance of highway engineering, including the functions of various organizations and classifications of roads.
2. Gain knowledge of road geometrics, including terms and concepts related to road design and cross-sections.
3. Learn about highway surveys and planning, including reading topographic maps and considerations for road alignment.
4. Study different road materials, including soil, aggregates, and binders, along with their properties and tests.
5. Explore road pavements, including flexible and rigid pavements, sub-base and base courses, and various surfacing types.
6. Understand the construction and maintenance of hill roads, including special considerations for hilly areas.
7. Gain insight into road maintenance practices, such as addressing common road failures and maintaining different types of roads.

## **DETAILED CONTENTS**

### **1. Introduction**

- 1.1 Importance of Highway engineering
- 1.2 Functions of IRC, CRRI, MORT&H, NHAI
- 1.3 IRC classification of roads
- 1.4 PMGSY and MNERGA Roads

### **2. Road Geometrics**

- 2.1 Glossary of terms used in road geo-metrics and their importance: Right of way, formation width, road margin, road shoulder, carriage way, side slopes, kerbs, formation levels, camber and gradient
- 2.2 Average running speed, stopping and passing sight distance
- 2.3 Necessity of curves, horizontal and vertical curves including transition curves. Super elevation and methods of providing super elevation
- 2.4 Sketch of typical cross-sections in cutting and filling on straight alignment and at a Curve (Note: No design/numerical problem to be taken)

### **3. Highway Surveys and Plan**

- 3.1 Topographic map, reading the data given on a topographic map
- 3.2 Basic considerations governing alignment for a road in plain and hilly area
- 3.3 Highway location; marking of alignment

#### **4. Road Materials**

4.1 Different types of road materials in use; soil, aggregate, binders – bitumen, cutback, Emulsion and Modified Bitumen (CRMB, PMB)

4.2 Binders: Common binders; bitumen, properties as per BIS specifications, penetration, softening point, ductility and viscosity test of bitumen, procedures and significance, cut back and emulsion and their uses, Bitumen modifiers

#### **5. Road Pavements**

5.1 Road pavement: Flexible and rigid pavement, their merits and demerits, typical cross-sections, functions of various components

5.2 Introduction to Sub Base Course and Base Course:

i) Granular base course:

- Water Bound Macadam (WBM)
- Wet Mix Macadam (WMM)

ii) Bitumen Courses:

- Bituminous Macadam
- Dense Bituminous Macadam (DBM)

iii) Methods of construction as per MORT&H

5.3 Surfacing:

i. Types of surfacing

- Prime coat and tack coat

ii. Surface dressing with seal coat

- Open graded premix carpet
- Mix seal surfacing
- Semi dense bituminous concrete

- Bituminous Concrete/Asphaltic concrete
- Mastic Asphalt

5.4 Rigid Pavements: Construction of concrete roads as per IRC specifications: Form work laying, mixing and placing the concrete, compacting and finishing, curing, joints in concrete pavement, equipment used.

## **6. Hill Roads:**

6.1 Introduction: Typical cross-sections showing all details of a typical hill road, partly in cutting and partly in filling

6.2 Special problems of hill areas

6.2.1 Landslides: Causes, prevention and control measures, use of geogrids, geoflexiles, geosynthetics

6.2.2 Drainage

6.2.3 Soil erosion

6.2.4 Snow: Snow clearance, snow avalanches, frost

6.2.5 Land Subsidence

## **7. Road Maintenance:**

7.1 Common types of road failures of flexible pavements: Pot hole, rutting, alligator cracking, upheaval - their causes and remedies (brief description)

7.2 Maintenance of bituminous road such as seal-coat, patch-work and recarpeting.

7.3 Maintenance of concrete roads-filling cracks, repairing joints, maintenance of shoulders (berms), maintenance of traffic control devices

## **8. Railway Engineering**

- 8.1 Introduction to Indian Railways
- 8.2 Railway surveys: Factors influencing the railways route, brief description of various types of railway survey
- 8.3 Classification of permanent way describing its component parts
- 8.4 Rail Gauge: Definition, types, practice in India, Rails – types of rails Rail Fastenings: Rail joints, types of rail joints, fastenings for rails, fish plates, bearing plates
- 8.5 Sleepers: Functions of sleepers, types of sleepers, requirements of an ideal material for sleepers, Ballast: Function of ballast, requirements of an ideal material for ballast
- 8.6 Maintenance of track: Necessity, maintenance of track, inspection of soil, track and fixtures; maintenance and boxing of ballast maintenance gauges, tools

## **9. Airport Engineering :-**

- 9.1 Necessity of study of airport engineering, aviation transport scenario in India.
- 9.2 Factors to be considered while selecting a site for an airport with respect to zoning Laws, Importance of Wind rose diagram in airport design.
- 9.3 Introduction to Runways, Taxiways and Apron.

**Note: An expert may be invited from field/industry for extension lecture on this topic.**

**PRACTICAL OUTCOMES:** At the end of the course, the student will be able to:

1. Understand the various processes related to the determination of various physical properties of Bitumen and their importance in road design.
2. Gain knowledge of different road materials, including soil, aggregates, and binders, along with their properties and tests.
3. Explore road pavements, including flexible and rigid pavements, sub-base and base courses, and various surfacing types.
4. Understand the construction and maintenance of hill roads, including special considerations for hilly areas.
5. Gain insight into road maintenance practices, such as addressing common road failures and maintaining different types of roads.

**List of Practicals:**

1. Determination of penetration value of bitumen
2. Determination of softening point of bitumen
3. Determination of ductility of bitumen
4. Determination of impact value of the road aggregate
5. Determination of abrasion value (Los Angeles) of road aggregate
6. Determination of the California bearing ratio (CBR) for the sub-grade soil
7. Visit to Hot mix plant
8. Visit to highway construction site for demonstration of operation of: Tipper, tractors (wheel and crawler), scraper, bulldozer, dumpers, shovels, grader, roller, dragline, road pavers, JCB etc.
9. Determination of Viscosity of Tar/Bitumen.

**Recommended Books:**

1. Khanna, SK and Justo, CEG, "Highway Engineering", Nem Chand and Bros., Roorkee
2. Vaswani, NK, "Highway Engineering", Roorkee Publishing House, Roorkee,
3. Priyani, VB, "Highway and Airport Engineering" Anand, Charotar Book Stall
4. Sehgal, SB; and Bhanot, KL; "A Text Book on Highway Engineering and Airport" S Chand and Co, Delhi
5. Duggal AK, Puri VP., "Laboratory Manual in Highway Engineering", New Age Publishers (P) Ltd, Delhi.
6. NITTTR, Chandigarh "Laboratory Manual in Highway Engineering",
7. Vaswani, NK, "Railway Engineering", Publishing House, Roorkee
8. Rangwala, SC, "Railway Engineering", Anand, Charotar Book Stall Rao, "Airport Engineering"
9. Singh Jagrup, "Highway Engineering", Eagle Publications Jalandhar

**IRC Publications:**

1. MORTH Specifications for Road and Bridge Works (Fifth Revision)
2. MORTH Pocket book for Highway Engineers, 2001.
3. MORTH Manual for Maintenance of Roads, 1983

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## **WATER SUPPLY AND WASTE WATER ENGINEERING**

<b>Course Code:</b>	024006
<b>Course Title</b>	Water Supply & Waste Water Engineering
<b>No. of Credits</b>	5 (TH:4,T:0,P:2)

**COURSE OUTCOMES-** At the end of the course, the student will be able to:

1. Gain a comprehensive understanding of water supply systems, including their necessity, components and functioning.
2. Develop the ability to determine water requirements, rate of demand, and per capita consumption for various uses.
3. Acquire knowledge of water quality analysis methods, including physical, chemical, and bacteriological tests.
4. Understand the principles and processes involved in water treatment, including sedimentation, coagulation - flocculation, filtration, and disinfection.
5. Learn about different types of pipes, appurtenances, and distribution systems for conveying water.
6. Develop an understanding of wastewater engineering, including sewage collection, sewerage systems, sewage characteristics, sewage treatment methods, and building drainage systems.



## **COURSE CONTENTS**

### **A. Water Supply**

#### **1. Introduction**

1.1 Necessity & brief description of water supply system.

#### **2. Quantity of Water**

2.1 Water requirement

2.2 Rate of demand and variation in rate of demand

2.3 Per capita consumption for domestic, industrial, public and fire fighting uses as per BIS standards (no numerical problems)

2.4 Population Forecasting

#### **3. Quality of Water**

3.1 Meaning of pure water and methods of analysis of water

3.2 Physical, Chemical and bacteriological tests and their significance

3.3 Standard of potable water as per Indian Standard

3.4 Maintenance of purity of water (small scale and large scale quantity)

#### **4. Water Treatment (brief introduction)**

\*\*4.1 Sedimentation - purpose, types of sedimentation tanks

\*\*4.2 Coagulation flocculation - usual coagulation and their feeding

- \*\*4.3 Filtration - significance, types of filters, their suitability
- 4.4 Necessity of disinfection of water, forms of chlorination, break point chlorine, residual chlorine, application of chlorine.
- 4.5 Flow diagram of different treatment units, functions of
  - (i) Aeration fountain
  - (ii) mixer
  - (iii) flocculator,
  - (iv) classifier,
  - (v) slow and rapid sand filters
  - (vi) Chlorination chamber.

## **5. Conveyance of Water**

- \*\*5.1 Different types of pipes - cast iron, PVC, steel, asbestos cement, concrete and lead Pipes. Their suitability and uses, types of joints in different types of pipes.
- 5.2 Appurtenances: Sluice, air, reflux valves, relief valves, scour valves, bib cocks, stop cocks, fire hydrants, water meters their working and uses
- 5.3 Distribution site: Requirement of distribution, minimum head and rate, methods of layout of distribution pipes
  - 5.3.1 Systems of water supply - Intermittent and continuous service reservoirs - types, necessity and accessories.
  - 5.3.2 Wastage of water - preventive measures
  - 5.3.3 Maintenance of distribution system
  - 5.3.4 Leakage detection

## **6. Laying out Pipes**

- 6.1 Setting out alignment of pipes
- 6.2 Excavation for laying of pipes and precautions to be taken in laying pipes in black cotton soil.
- 6.3 Handling, lowering beginning and jointing of pipes
- 6.4 Testing of pipe lines
- 6.5 Back filling
- 6.6 Use of boning rods

## **7. Building Water Supply**

- 7.1 Connections to water main (practical aspect only)
- \*\*7.2 Water supply fixtures and installations and terminology related to plumbing

## **B. WASTE WATER ENGINEERING**

### **8. Introduction**

- 8.1 Purpose of sanitation
- 8.2 Necessity of systematic collection and disposal of waste
- 8.3 Definition of terms in sanitary engineering
- 8.4 Collection and conveyance of sewage
- 8.5 Conservancy and water carriage systems, their advantages and Disadvantages
- 8.6 (a) Surface drains (only sketches) : various types, suitability
  - (b) Types of sewage: Domestic, industrial, storm water and its seasonal variation

## **9. Sewerage System**

9.1 Types of sewerage systems, materials for sewers, their sizes and joints

9.2 Appurtenance: Location, function and construction features. Manholes, drop manholes, tank hole, catch basin, inverted siphon, flushing tanks grease and oil traps, storm regulators, ventilating shafts

## **10. Laying and Construction of Sewers:**

10.1 Setting out/alignment of sewers

10.2 Excavations, checking the gradient with boning rods preparation of bedding, handling and jointing testing and back filling of sewers/pipes.

10.3 Construction of surface mains and different sections required

## **11 Sewage characteristics:**

11.1 Properties of sewage and IS standards for analysis of sewage

11.2 Physical, chemical and bacteriological parameters

## **12. Natural Methods of Sewerage Disposal**

12.1 General composition of sewage and disposal methods

12.2 Disposal by dilution

12.3 Self purification of stream

12.4 Disposal by land treatment

12.5 Nuisance due to disposal

### **13. Sewage Treatment**

- 13.1 Meaning and principle of primary and secondary treatment and activated sludge process their flow diagrams
- 13.2 Introduction and uses of screens, grit chambers, detritus tanks, skimming tanks, plain sedimentation tanks, primary clarifiers, secondary clarifiers, filters, control beds, intermittent sand filters, trickling filters, sludge treatment and disposal, oxidation ponds (Visit to a sewage treatment plant)

### **14. Building Drainage**

- 14.1 Aims of building drainage and its requirements
- \*\*14.2 Different sanitary fittings and installations
- 14.3 Traps, seals, causes of breaking seals

**Note: \*\* A field visit may be planned to explain and show the relevant things.**

**PRACTICAL OUTCOMES** : At the end of the course, the student will be able to:

1. Determine turbidity, dissolved oxygen, pH value, BOD, residual chlorine, conductivity, and TDS in water samples to assess water quality.
2. Perform jar tests to optimize coagulation processes and understand their significance in water treatment.
3. Evaluate the bacteriological quality of drinking water to ensure safety.
4. Study the installation processes of water meters, building water supply connections, pipe valves and bends, and water supply and sanitary fittings.
5. Demonstrate the joining/threading of various types of pipes and understand their application in water supply and drainage systems.
6. Visit a field laboratory to observe water purification processes and gain practical insights into water treatment methods.

**List of Practicals :**

1. To determine turbidity of water sample
2. To determine dissolved oxygen of given sample
3. To determine pH value of water
4. To perform jar test for coagulation
5. To determine BOD of given sample
6. To determine residual chlorine in water
7. To determine conductivity of water and total dissolved solids
8. To study the installation of following:
  - a. Water meter
  - b. Connection of water supply of building with main
  - c. Pipe valves and bends
  - d. Water supply and sanitary fittings
9. To determine Bacteriological Quality of Drinking Water
10. To study and demonstrate the joining/threading of GI Pipes, CI Pipes, SW pipes, D.I. pipes and PVC pipes.
11. To demonstrate the laying of SW pipes for sewers
12. Study of water purifying process by visiting a field lab.
13. To test house drainage
14. To determine TDS by TDS meter.

### **Recommended Books:**

1. Duggal, KN; “Elements of Public Health Engineering”;; S. Chand and Co. New Delhi
2. Rangwala, SC; “Water Supply and Sanitary Engineering”;; Anand Charotar Book Stall
3. Kshirsagar, SR; “Water Supply Engineering”;; Roorkee Publishing House, Roorkee
4. Kshirsagar, SR; “Sewage and Sewage Treatment”;; Roorkee, Roorkee Publishing House
5. Hussain, SK; “Text Book of Water Supply and Sanitary Engineering”;; Oxford and IBH Publishing Co, New Delhi,
6. Birdie, GS; “Water Supply and Sanitary Engineering”;; Dhanpat Rai and Sons, Delhi
7. Garg, Santosh Kumar; “Water Supply Engineering”;; Khanna Publishers, Delhi
8. Garg, Santosh Kumar; “Sewage and Waste Water Disposal Engineering”;; Khanna Publishers, Delhi
9. Steel, EW; “Water Supply and Sewerage”;; McGraw Hill.
10. Duggal, Ajay K and Sharma, Sanjay, “A Laboratory Manual in Public Health Engineering”, , Galgotra Publications, 2006, New Delhi
11. Gurjar,B.R. “ Sludge Treatment & Disposal” Oxford and IBH Co Pvt Ltd NewDelhi.
12. Mahajan Sanjay, Water Supply and Waste Water Engineering, Satya Prakashan Ltd., Delhi.

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## **SOLID WASTE MANAGEMENT**

<b>Course Code:</b>	444003
<b>Course Title</b>	Solid Waste Management
<b>No. of Credits</b>	4 (TH:4,T:0,P:0)

**COURSE OUTCOMES:** At the end of the course, the student will be able to:

1. Understand the generation, classification and characteristics of solid waste, and the analysis and processing methods involved.
2. Gain knowledge of the solid waste system, including collection, storage, transportation, and disposal techniques.
3. Learn about different waste processing techniques such as biological reprocessing, sanitary landfill, waste-to-energy, incineration, and composting.
4. Explore the concept of resource recovery from solid waste, including conversion products and energy generation.
5. Understand the environmental impact of solid waste on air, water, and land.
6. Develop an awareness of recommended learning resources, including manuals on municipal solid waste management and solid waste management from reputable organizations.

## **COURSE CONTENTS**

### **1. Introduction:**

- 1.1. Generation of solid waste
- 1.2. Classification of solid waste
- 1.3. Characteristics of solid waste
- 1.4. Analysis and processing of solid waste

### **2. Solid Waste System:**

- 2.1. Collection
- 2.2. Storage
- 2.3. Transportation
- 2.4. Disposal system

### **3. Waste Processing Techniques:**

- 3.1. Biological reprocessing
- 3.2. Sanitary landfill
- 3.3. Waste-to-energy
- 3.4. Incineration
- 3.5. Composting

### **4. Recovery of Resources:**

- 4.1. Conversion products
- 4.2. Energy generation

### **5. Impact of Solid Waste on Environment:**

- 5.1. Air
- 5.2. Water
- 5.3. Land

**Suggested Learning Resources:**

1. Manual on Municipal solid waste management, CPHEEO, Ministry of Urban Development, Government of India.
2. WHO manual on solid waste management.

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**‘Audit Course’  
ESSENCE OF INDIAN  
TRADITIONAL KNOWLEDGE**

<b>Course Code</b>	AS401
<b>Course Title</b>	Essence of Indian Traditional Knowledge
<b>No. of Credits</b>	0 (TH:2,T:0,P:0)

**COURSE OUTCOMES:** After completion of this course, student will be able to:

1. Develop a comprehensive understanding of the essence of Indian knowledge and tradition.
2. Explore the rich philosophical systems of ancient India and their relevance today.
3. Gain familiarity with the Vedic literature and scriptures, and appreciate their wisdom.
4. Analyze Indian epics and mythology to understand their cultural and spiritual significance.
5. Learn and apply principles of yoga, meditation, and mindfulness for personal well-being.
6. Discover the principles and practices of Ayurveda and natural healing for holistic health.

## **COURSE CONTENTS**

1. Introduction to Indian Knowledge and Tradition
2. Ancient Indian Philosophical Systems
3. Vedic Literature and Scriptures
4. Indian Epics and Mythology
5. Yoga, Meditation, and Mindfulness Practices
6. Ayurveda and Natural Healing Systems
7. Indian Classical Arts and Music
8. Indian Architecture and Sculpture
9. Indian Festivals and Rituals
10. Ethical and Moral Values in Indian Culture

### **References /Suggested Learning Resources:**

1. "Indian Philosophy: A Very Short Introduction" by Sue Hamilton
2. "The Vedas: An Introduction to Hinduism's Sacred Texts" by Roshen Dalal
3. "The Ramayana: A Shortened Modern Prose Version of the Indian Epic" by R.K. Narayan
4. "The Upanishads" translated by Eknath Easwaran
5. "Autobiography of a Yogi" by Paramahansa Yogananda
6. "Ayurveda: The Science of Self-Healing" by Dr. Vasant Lad.

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## **MINOR PROJECT WORK**

<b>Course Code:</b>	AS402
<b>Course Title</b>	Minor Project Work
<b>No. of Credits</b>	2 (TH:0,T:0,P:4)

### **OBJECTIVE:**

The Minor Project work is an integral part of the Engineering Diploma program, designed to provide students with an opportunity to apply theoretical knowledge gained throughout their studies to real-world engineering challenges. This module aims to foster creativity, problem-solving abilities, and practical skills essential for successful engineering professionals.

**PRACTICAL OUTCOMES:** After undergoing the minor project work, the student will be able to:

1. Understand the practical applications of engineering concepts in real-world scenarios.
2. Develop hands-on experience in designing, implementing, and testing engineering projects.
3. Enhance problem-solving and critical thinking skills through project execution.
4. Improve documentation and presentation skills for effective project communication.

### **GENERAL GUIDELINES:**

#### **1. Introduction to Minor Projects**

- Overview of the module's purpose and objectives
- Importance of practical application in engineering
- Understanding the project life cycle and its stages

## **2. Project Ideation and Proposal Development**

- Identifying engineering problems and project ideas
- Formulating clear project objectives and scope
- Developing a comprehensive project proposal

## **3. Project Planning and Management**

- Creating a project plan with defined milestones and timelines
- Resource allocation and budgeting for the project
- Risk assessment and mitigation strategies

## **4. Engineering Design and Analysis**

- Principles of engineering design and problem-solving
- Conducting feasibility studies and simulations (if applicable)
- Engineering analysis techniques and tools

## **5. Prototyping and Implementation**

- Hands-on development of project prototypes
- Conducting experiments and data collection
- Troubleshooting and problem-solving during implementation

## **6. Project Documentation and Reporting**

- Techniques for effective project documentation
- Writing comprehensive project reports and design documentation
- Organizing and presenting project data

## **7. Project Presentation and Communication**

- Principles of effective communication in engineering
- Preparing engaging & informative project presentations
- Addressing questions & feedback during the presentation

## **8. Project Evaluation and Assessment**

- Criteria for evaluating project success and achievement of objectives
- Conducting fair and unbiased project assessments
- Peer evaluations and constructive feedback.

## **ACTIVITIES AND EXECUTION GUIDELINES**

### **1. Project Proposal Submission:**

Students will submit their project proposals to the assigned mentors. The proposals should be well-structured, indicating the project's significance, expected outcomes, resources required, and a preliminary plan of action.

### **2. Project Execution:**

During this period, students will work on their projects under the guidance of their mentors. They are encouraged to employ innovative techniques and apply engineering principles to achieve project objectives successfully.

### **3. Project Documentation:**

Students will submit their final project reports and related documentation. The documentation should encompass all project phases, methodologies, experimental data, analysis, and outcomes.



#### **4. Project Presentation:**

Each student will deliver a comprehensive presentation to a panel of evaluators, showcasing their project's key aspects, results, and conclusions.

### **ASSESSMENT CRITERION**

#### **1. Project Proposal and Objective (10%)**

Students are required to submit a comprehensive project proposal outlining the problem statement, objectives, scope, and methodology of the project. This component will account for 10% of the total marks.

#### **2. Project Implementation (60%)**

The core of the assessment will be based on the successful implementation of the project. Students will be evaluated on their ability to execute the project plan, adhere to timelines, and demonstrate practical engineering skills. This segment will carry 60% of the total marks.

#### **3. Documentation (15%)**

Proper documentation is vital to effective project management and communication. Students will be evaluated on the clarity, completeness, and organization of their project reports, design diagrams, code (if applicable), and any other relevant material. This component will contribute 15% of the total marks.

#### **4. Project Presentation (15%)**

Communication and presentation skills are crucial for engineers to articulate their ideas effectively. Students will be assessed based on their ability to present their project's

objectives, methodology, results, and conclusions in a clear and concise manner. This segment will be worth 15% of the total marks.

**The Minor Project module is a pivotal component of the Engineering Diploma program that provides students with hands-on experience, encourages critical thinking, and prepares them for real-world engineering challenges. By adhering to the module guidelines and distribution of marks, students can excel in their projects and demonstrate their engineering prowess effectively.**

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